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# THE RIKEN WAY AND EUROPE

## Scientific work, organisation of research, culture of merit, recognition of talent

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# The Riken Way and Europe.
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*«Whenever humanity seems condemned to heaviness, I think I should fly like Perseus into a different space. I don't mean escaping into dreams or into the irrational. I mean that I have to change my approach, look at the world from a different perspective, with a different logic and with fresh methods of cognition and verification. The images of lightness that I seek should not fade away like dreams dissolved by the realities of present and future. […] Today every branch of science seems intent on demonstrating that the world is supported by the most minute entities: such as the messages of Dna, the impulses of neurons, and quarks, and neutrinos wandering through space since the beginning of time. […] The second industrial revolution, unlike the first, does not present us with such crushing images as rolling mills and molten steel, but with bits in a flow of information travelling along circuits in the form of electronic impulses. The iron machines still exist, but they obey the orders of weightless bits.»*

Italo Calvino

### 1. So many reports, so many questions

How do we organise genius, reward merit, recognise talent? And how do we define paths and strategies, adopt good practices to support scientific

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research and innovation, develop networks and virtuous relations between universities, research institutes and business, learn from successful experiences and models in Europe and the world? And again: is it the processes started by people, with their ideas, their talent, their work, the quality and quantity of their relations, connections and interactions that determine the history and nature, success and failure of organisations? Or is it the strength and substance of the organisations where they live, work, study and enjoy themselves that make the difference? And last of all: what are the characteristics of the relation between people and organisation in centres where there is innovation and a high degree of specialisation and professionalism? What is one evaluating when the object is innovation and research? And how does one make the process of evaluation cogent and its conclusions decisive?

So many reports, so many questions, one might say, like Bertold Brecht's worker who reads[1]. Giving a sense to the various reports and offering answers to all the questions is the aim of this paper, which is the result of an analysis carried out between December 2005 and April 2008 of how Rikagaku Kenkyusho (Riken), a world-famous Japanese research institute, is organised[2].

There are no final answers – for many reasons, not least that in the domain of limited rationality, solving a problem also means creating the premises for a new one to emerge from somewhere. We shall instead try to describe useful contexts, credible hypotheses, possible starting-places for later, endless explorations – starting from an idea: that we can achieve our aim by talking about innovation and how it is conceived, sought and achieved at Riken, and about how and why the Riken way can provide suggestions useful to scientific research and create opportunities that are new to Europe, and still more to Italy, help spread virtuous behaviour and good practice, set off processes of isomorphism, encourage the circulation of good minds and halt the brain drain, and encourage the young not to abandon the exacting but exciting path of science.

[1] Brecht B. (1987), *Questions of a worker who reads* in *Poems, 1913*-1956, London, Methuen.

[2] I wish to thank Sabato Aliberti, Bianca Arcangeli, Salvatore Casillo, Massimo Del Forno and Cinzia Massa for their extremely valuable suggestions.

## 2. The stages and protagonists of the research

There were two main stages to the research, one based on documents and the other in the field. The documents concerned the history, structure, duties and organisation of Riken, its main research activities, the variables used in that context to gauge the effectiveness and measure the efficiency of the various institutes that make it up. The main sources were Riken's Annual Report 2006-2007; the budget for the tax years 2007 and 2008; the sixth Riken Advisory Council Report; the fourth Frontier System Research Advisory Council[3]; Japan's Science & Technology Budget for the tax years 2006, 2007 and 2008; and the 2007 Oecd report Science, Technology and Industry.

This was an important part of the framing work[4] and the social recognition of Riken's context of action; it provided a first glance at the territory, its critical features and resources, and questions connected with the Riken system; it helped us draw up a methodology for analysing its organisation and understanding its processes of competition-collaboration and decision-making, how it sets up sense-making processes and serendipitous socio-cognitive environments in a scientific context, and handles and develops human resources; at a stage in which, inevitably, there was still more shade than light, it allowed us to grasp a fundamental critical success factor[5] in the capacity of those at every level of the Riken organisation to pull all this together into a system.

The field research took place in March 2008 at the Riken headquarters, at Riken Wako and at the Riken Yokohama Institute, and consisted of active observation conducted with the help of interviews, non-directed conversations[6],

[3] The institutes and centres that make up Riken were reorganised in April 2008. One of the results of this reorganisation was the fusion of the Frontier Research System and the Discovery Research Institute in the Advanced Science Institute.

[4] As is generally known, Erving Goffman is the author of the idea that to understand a flux of events we need a cognitive framework that allows us to place it in a social context; that the transition from one level of reality to another and the handling of social complexity can be translated into the activity of removing and adding frames.

[5] Characteristic of the internal or external environment of an organisation that has an important influence on achieving its aims.

[6] See Rogers C.R. (1951), *Client-centered therapy: Its current practice, implications and theory*, Boston, Houghton Mifflin; Lumbelli L. (1972), *Comunicazione non autoritaria,* Milan, Franco Angeli.

and scraps of daily life including such distinguished figures as Ryoji Noyori[7], Akira Tonomura[8], Yoshihide Hayashizaki[9], Piero Carninci[10], Franco Nori[11], Yasuaki Yutani[12], Soh Osuka[13], Philippe de Taxis du Poët[14], Angelo Volpi[15], Fabio Marchesoni[16] and Valerio Orlando[17].

In this case the intention was to discover in the processes we examined the shared representations, the dynamics of sense-building, the level and quality of the involvement of the subjects who direct and make up the units, and to grasp implicit and explicit rules and motives and interaction processes.

The prospect, which, oddly, might link up with Merton's ideas as much as with the "sociology of scientific knowledge", might be that of a science that rejects the concept of technology without innovation, and so needs a creative synthesis of competition and collaboration; a science that lets itself be guided by strategies more than rhythms; and that is not interested in a purely muscular kind of competition. The idea and hope is that this prospect

[7] President of Riken, Nobel Prize 2001 for Chemistry for his study of the production of chiral catalysts, Member of the Japan Academy, Member of the Pontifical Academy of Sciences, Fellow of the American Association for the Advancement of Science, Honorary Member of the Chemical Society of Japan, Honorary Fellow of the Royal Society of Chemistry (Great Britain), Honorary Foreign Member of the American Academy of Arts and Sciences, Honorary Member of the European Academy of Sciences and Arts.

[8] Fellow at Hitachi Ltd., Member of the Science Council of Japan and the Japan Academy, Director of the Single Quantum Dynamics Research Group (which includes the Dml).

[9] Director of the Omics Science Centre and the Genome Science Laboratory, Director of the Genome Exploration Research Group, Director of the programme of Functional Rna Research.

[10] Leader of the Functional Genomics Technology Team and the Omics Resource Development Unit, Vice-Director of the Lsa Technology Development Group.

[11] Team leader of the Digital Materials Laboratory (since April 2008 Digital Materials Team).

[12] Director of the Personnel Division of Riken.

[13] Member of Research Priority Planning at the Research Priority Committee.

[14] First Chief Advisor of the Science & Technology Section of the Eu delegation in Japan.

[15] Attaché Science & Technology Italian Embassy in Japan.

[16] Professor of Physics at the University of Camerino, *Commendatore* of the Italian Republic for scientific merits, Visiting Professor at Loughborough University (Great Britain), former Fellow of the American Physical Society (United States), the Institute of Physics (Great Britain), and the Alexander von Humboldt (Germany).

[17] Team leader of the Dulbecco Telethon Institute, President of the Italian Society of Biophysics and Molecular Biology; he was the only one of the contributors not to be interviewed in Japan but in Naples.

may prove something new, a step towards building a new paradigm of knowledge that may have positive effects for Europe and Italy[18].

In this part of the research there are normally three phases: the entry phase, when the researcher makes himself familiar with the environment, the subjects that are part of it, and their work and routine; the observation and collection phase, in this case performed with the tools described above; and that of analysing and formulating the contents.

Despite its natural limitations and difficulties, the activity of participatory observation allowed us to grasp the organisational characteristics of the Riken system analytically; the viewpoints and behaviours of the main subjects who are part of it or who, for various reasons, have long-established relations with it; and some important dynamics of and between the groups.

The qualitative approach also explains why the results were presented with a narrative-descriptive structure, rooted in the real world, specifically that of scientific research; as well as the constant attempt to interact directly and empathise with the object studied and the subjects that are part of it.

## 3. The cognitive framework

Eight authors, three concepts, three foundation walls of which one might almost say that they are carried by the whole house[19], and a specific interpretation of the concept of innovation will help us in two ways. It will make us familiar with the box of tricks used to outline and connect all the different elements of scientific research (hopefully with some new perspective), and also help us place the facts, questions and events in their context, give them meaning, and understand them better[20].

## 4. The eight horsemen of organisational thought

Let us begin with Max Weber and Frederick W. Taylor, with thought that has no room for hesitations and admits no replies. Their theories are expres-

[18] For mainly objective reasons an in-depth analysis of the context analysed, as well as the presentation of the model proposed and its premises will be published in a later volume.

[19] Wittgenstein L. (1978), *On Certainty,* Oxford, Basil Blackwell, para. 248

[20] See Goffman E. (1974), *Frame Analysis, an essay on the organization of experience* London, Harper and Row.

sions of absolute rationality[21], the search for ideal organisation, perfect structure, and the impersonal man – without qualities: a simple wheel to be synchronised with the exemplary workings of bureaucracy or industry.

With Chester I. Barnard and the theory of organisation as a cooperative system, we start the long march towards subjectivity; the new function of the manager and the characteristics he needs to determine a more useful and fair balance between incentives and contributions make their entry into organisational analysis.

Thanks to Herbert A. Simon the concept of limited rationality became the key for understanding and interpreting the otherwise inaccessible space between the rational and non-rational aspects of the social behaviour of organisations. Since Simon they can be defined starting from the complex and varied system of relations that is created between the members of the organisation, and that gives them information, the conditions for making decisions, aptitudes, and aims, which in turn influence individual decisions and expectations. For Simon the decision-making conditions, the mental construction of a simplified model of reality, are the unit of analysis needed to understand the way organisations really work.

Although I refer above all to his concept of serendipity in this article, sociology owes much more to Robert K. Merton: one need only think, for example, of his medium-range theories applicable to limited series of data but not just to simply describing the phenomena, of his definition of manifest and latent functions in social behaviour, and his reworking of the concept of anomie.

With his theory of structuration Anthony Giddens in his turn suggests that we need to look at social practices, at the resources and rules that inform the way we behave in our daily lives, as the key for understanding how organisations work, avoiding the imperialism of both subjects and structures.

With Edgar H. Schein organisational thought takes a cultural approach and asks in what sense and why organisations can be understood, starting from their established organisational cultures, as these are their basic assumptions, and in what way these differ from artefacts and explicit values.

Lastly, Karl E. Weick's theory of sensemaking, the idea that giving logical order and sense to a flux of experience is exactly the same as organising; the

[21] This is not to deny, of course, that the two authors are very different, and have different value systems and attitudes towards rationality and modernity.

idea is that the processes of conferring sense allow us to interpret, understand and activate the environments in which people operate and with which they interact[22].

## 5. Three concepts

Decisions, sensemaking and serendipity are the three concepts that, for various reasons, it is useful to define specifically in the context of this article. As a start, let us say that taking a decision is a much more demanding matter, much less linear and banal, than we generally tend to think. Not only because it may be the upshot of the deliberate plan of a rational subject, and in this case it will have been taken on the basis of the synoptic decision-making model; it may be the contingent result of a process conditioned by the subjective and objective limits of human rationality, and here we are dealing with the bounded-rationality model; it may be the result of mediations and arrangements between partisan subjects – the incremental decision-making model; or it may be the accidental result of a meeting of problems, solutions, participants and opportunities to choose, and in this case it is the garbage-can model; it can be taken on the basis of choices that can be classified as behavioural, political-administrative or participatory models[23]. But also because, even when we are not aware of it, no matter how many the decision-makers and what the context in which it is made, a decision has a process behind it that produces often surprising results if and when it is carried out fully.

An example of this can be found in Sidney Lumet's 1957 masterpiece, *Twelve Angry Men*[24]. The decision-making process by which the 12 jurymen in question decide on the innocence of the boy accused of killing his father is a textbook case – prophetic indeed. It anticipates the results of Garfinkel's research[25] on the decision-making process of juries, which shows how, in-

[22] See Moretti V. (2008), *Dizionario del pensiero organizzativo,* third edition revised and extended, Rome, Ediesse.

[23] See March J. (2002), *Prendere decisioni,* Bologna, Il Mulino; Moretti V. (2008), *op.cit.,* pp. 70-77.

[24] The cast included Henry Fonda, Lee J. Cobb, Ed Begley, E.G. Marshall and Martin Balsam.

[25] See Garfinkel H. (1967), *Studies in ethnomethodology*, Prentice Hall, Englewood Cliffs (New Jersey).

stead of following the chain harm-its seriousness-attribution of blame-definition of punishment, they tend, as Weick suggests, to make the facts make sense retrospectively to support the choice of verdict[26].

Peter Drucker comments interestingly on the differences between the West and Japan as to what "taking a decision" means. In the West the emphasis is on the possibility-need to approach the "answer to the question" systematically. In Japan, by contrast, the fundamental element, the essence of the decision, is the definition of the question; to the extent that the answer to the question, what is the decision for westerners, depends on its definition, the decision-making process can be a matter of determining what actually concerns the decision rather than what decision should be taken[27].

Chaplin's "speech to mankind" in *The Great Dictator* is one of the most marvellous, moving and involving examples of sensemaking of all times[28]. Weick defines sensemaking as a retrospective process founded on the construction of identity, which creates environments that are sensible, social, continual, centred on (and by) selected information, guided by plausibility more than precision.

According to Weick reality has no meaning in itself, but only that attributed to it by people. Of course, this does not mean that reality does not impinge on the flux of experience, as subjects and activated environment are linked by a constant retroactive process; more simply, it means that our behaviour follows causal maps – the structures of meaning and logical order, produced by cognitive activity – and these maps are modified by gradually accumulating experiences. Weick points out that giving logical order and meaning to a flux of experience and organising are identical, and that the processes by which, for example, a manager defines strategic choices, decides his investment priorities and assigns tasks to his team are the same as the processes by which he gives meaning to relations with his team members, his competitors, his suppliers and the banks.

[26] Weick K.E. (1997), *Sensemaking in organizations,* Thousand Oaks, Sage.

[27] Equally interesting are the arguments used by Angelo Volpi to explain why the decision-making process in Japan is extremely slow in the phase of undertaking the decision, and becomes extremely fast in the execution phase: being based on the search for large-scale agreement, it requires all those taking part in the process to be heard and to accept to some extent the solution. If one side loses completely, there is no harmony in the process; when all are involved, no part of the question can be reopened.

[28] See Weick K.E. (1997), *op.cit.*

Finally, serendipity, which refers to the fairly common experience of observing an unexpected, anomalous and strategic fact that allows one to develop a new theory or extend one already existing[29]. Merton underlines that the fact is unforeseen because attempts to verify a hypothesis give rise to a chance by-product, an unexpected observation, which has repercussions on theories that, at the outset of the research, were not in question. The observation is anomalous and surprising because it seems to contradict the prevailing theory or the established facts. The surprise and the seeming incongruence arouse curiosity and drive the researcher to give meaning to the new fact, to place it in a wider perspective of knowledge. The unforeseen fact becomes strategic and has implications that impinge on the general theory precisely thanks to what the observer adds to the fact, and this explains why it is indispensable for the observer to be theoretically aware and able to seize the universal from the particular.

Serendipity is relevant here, claims Merton, because at least four interests converge: a sociological interest in the general phenomenon of the unintended consequences of intentional actions; a methodological interest in the logic of theory; an interest in the history and sociology of science; and an interest in neologisms that force us to describe phenomena that have just been discovered and ideas that have just emerged[30]. What makes serendipity a systemic psycho-sociological concept are its connections with ideas such as self-simplification, independent multiple inventions, the fertility of empirical research, the integration of the psychological and sociological perspectives, and a change of paradigm[31].

## 6. The three foundation walls

The urgent, conscious need to reconstruct the different phases of Riken's research activities as they *really* happen is the first of the foundation walls that will help us reveal our basic convictions. As Richard P. Feynman claimed in his speech on receiving the Nobel Prize for Physics in 1965, "We have a habit

[29] See Merton R.K. and Barber E. (2004), *The travels and adventures of serendipity*, Princeton, Princeton University Press.

[30] Merton R.K and Barber E. (2004), *op.cit.*

[31] Merton R.K. and Barber, E., *op.cit.*

in writing articles published in scientific journals to make the work as finished as possible, to cover all the tracks, to not worry about the blind alleys or to describe how you had the wrong idea first, and so on. So there isn't any place to publish, in a dignified manner, what you actually did in order to get to do the work[32]".

Once again it is Merton who recalls the distinctions Piaget made between the personal way of developing one's thoughts and the order in which they are presented to others; the discrepancies between the actual course of scientific enquiry and its public documentation; and the scientific falsification in sociological terms of the Standard Scientific Article by virtue of Obliterated Scientific Serendipities.

The idea is that if the public documentation of science is unable to supply much of the material we need to reconstruct the actual course of a scientific enquiry, if it appears with a face that reveals little or nothing of the intuitions, false starts, errors, approximate conclusions and happy accidents that encumber research work, it ends up being misleading.

The second foundation wall recalls that, despite the lack of linearity, the many contradictions and the new forms of Taylorism rising up here and there, there has been significant advance from Weber to Weick, from the times when work and workers were represented by an ideal bureaucracy, the Fordist factory and the alienated little man magically played by Chaplin in *Modern Times*.

In short, the fact that the depiction of the knowledge worker choosing information, establishing relations and building connections, with all the necessary know-how, throughout his life, belongs more often to the bureaucratic optimism of documents than the real world, is not enough to negate the fact that over the years the individual has become more and more the fundamental element, the strategic factor, in defining and understanding organisation processes and in solving the dilemmas that are inevitably associated with these processes. For as long as human beings like ourselves are doing the paperwork, the possibility of balancing the equation and eliminating *tout court* the anomalies simply does not exist[33]; the successors of Hal 9000 will not be absolutely incapable of making a

[32] Quoted in Merton R.K. and Barber E. (2004), *op.cit.*

[33] The reference, of course, is to *Matrix Reloaded* (directed by Lawrence and Andrew Wachowski).

mistake[34]; concepts like error, autonomy, unpredictability, genius, plurality, conflict and, of course, actions, behaviours, social processes and cultures, which are associated with these processes, will continue to make the role of subjects indispensable.

The third and last foundation wall tells us that all this does not make the importance of structures less inexorable. The contexts and organisation processes that people have behind them are very important; it is the organisational level of scientific institutes that makes the difference, their will, possibility and capacity to support the experiences, intuitions and know-how of researchers. And this simply makes it more urgent to define theories, reasoning, arguments and verifiable prospects, as in the best social-sciences tradition.

As we shall see, not surrendering to the people-institutions subjects-structures dichotomy means above all thinking about the cultural, social, organisational and financial resources necessary to support innovation and organise research. It means good science, merit and talent. Today more than ever these are fundamental aspects of any credible strategy that refuses to give up the duty of imagining societies that are fairer, more sustainable and more modern, where one can live better.

## 7. The specific explanation

In their hypermodern workshops the gods of technology work unceasingly to overturn the dogmas that made the giants who came before them what they are. From nano-sciences to life sciences, to robotics, the present becomes past more and more rapidly. New ideas, continuity in work and discontinuity in approaches allow us to reach goals all the time. The alphabet of innovation is constantly changing: organisational learning, brain circulation, collaboration, competition, knowledge, knowing organization, open source, outsourcing, decision-making processes, networks, sensemaking, quality systems, serendipity, talent, evaluation. Each word a concept. Each concept a meaning. Each meaning, so many possible directions. One risks ending up like Asterione[35].

[34] In this case the film is *2001 A Space Odyssey* (directed by Stanley Kubrick).

[35] The reference is to the short story by J.L Borges. (2004), *The Aleph and other stories*, London, Penguin.

The specific explanation has the aim of helping us avoid this drift, to choose the red tablet that can keep us in wonderland, make us discover how deep the rabbit-hole of innovation, good science and talent is[36].

The idea is that in the context of this article the red tablet is "merit", not just in the sense of a fundamental indicator of people's abilities-capacities or of the quality or effectiveness of their actions, but also as a value, a fundamental reference point in defining strategies for overcoming imbalances and divisions, and defining the rules of fairer societies – that is to say, ones that can protect people's capacities to realise their life projects on the basis of the chances they are offered in the form of rights and resources, social ties, capacities (the concrete possibilities of life) and qualifications (the number of capacities which each person actually has at his disposal)[37].

The paths of merit are paved not only with extraordinary opportunities, starting from those connected with concepts of fairness and efficiency, but also with (substantial and formal) violations, ambiguities and contradictions, both of which are analysed aptly and in depth in an excellent joint work coordinated by Elena Granaglia[38]. This simply makes clearer that the specific explanation is a wager, and, in the Italy of this declining decade of the XXI century, is even a dream.

The idea is that one can win the wager and must make one's dream a reality. In backing merit so as to seize fresh opportunities for organising and developing scientific research, mate subject with structure, individual with organisation, and extend the areas of intersection between western and eastern thought, using the fundamental factors in situations, betting on polymorphism, the *metis*, intelligence and people's potential.

A concept of merit. All these conceptions. Endless good practices - to invert the compass needle and prevent decline. Here, and now.

## 8. What is Riken?

Riken's history goes back almost a hundred years and includes many celebrated figures. Such as Dairoku Kikuchi, the distinguished mathematician;

[36] In *Matrix* (directed by Lawrence and Andrew Wachowski).

[37] See Sen Amartya K. (1999), *Development as freedom,* Oxford, Oxford University Press.

[38] See Granaglia E. (2008), *Il merito: talento, impegno, caso, le ombre dell'Italia,* in *La Rivista delle Politiche Sociali,* no. 2, April-June.

Kikunae Ikeda, who discovered monosodium glutamate and the taste called *umami*; Hantaro Nagaoka, who was the first to think of the Saturnian model of the atom; Kotaro Honda, inventor of KS steel; Umetaro Suzuki, who discovered vitamin B1; Torahiko Terada, physicist and essayist; Yoshio Nishina, an extraordinary atomic physicist who worked with Bohr, Einstein, Heisenberg and Dirac; Hideki Yukawa, Nobel Prize for Physics in 1949 for predicting pions; Shinichiro Tomonaga, who won the Nobel in 1965 for his work on quantum electrodynamics; and Ryoji Noyori, the current President, who – as we have seen – won the Nobel Prize in 2001.

It is made up of various institutes and research centres: Riken Headquarters[39], the Wako Institute[40], the Tsukuba Institute[41], the Harima Institute[42], the Yokohama Institute[43] and the Kobe Institute[44]. Its activities cover every scientific and technological field[45] and, despite the many different approaches and perspectives of the various institutes, they all share the desire to hold together various frameworks, capacities, abilities, bents and competencies.

President Noyori describes Riken as a centre for project research where decisions are taken following a top-down process, starting naturally from management, with bottom-up processes generated by the decisions and activities of the researchers; he recalls that publishing the results both of scientific research and technological development is an important part of the way the institute organises its work; he underlines that a research environment with so many opportunities and with a swift and dynamic turnover[46] allows them to devote 85% of their resources to short-term contracts and have only 15% permanent staff, most of them administra-

[39] It includes the Centre for Intellectual Property Strategies, Next-Generation Supercomputer R&D Centre, SPring-8 Joint Project for XFEL, Riken Singapore Representative Office, and Riken China Office.

[40] It includes the Advanced Science Institute, Brain Science Institute, and Nishina Centre for Accelerator-Based Science.

[41] It includes the BioResource Centre.

[42] It includes the Riken SPring-8 Centre.

[43] It includes the Plant Science Centre, Centre for Genomic Medicine, Research Centre for Allergy and Immunology, Omics Science Centre, Systems and Structural Biology Centre, Bioinformatics and Systems Engineering Division, and the Centre of Research Network for Infectious Diseases.

[44] It includes the Centre for Developmental Biology, and the Molecular Imaging Research Program.

[45] Apart from the human and social sciences.

[46] This is a crucial characteristic of research institutes that seek excellence.

tive personnel. This is very different from most academic institutions where most of the personnel are taken on indefinitely.

In April 2008 there were 2,910 researchers working for Riken, 162 special postdoctoral researchers, 138 junior research associates, 11 foreign postdoctoral researchers, 2,636 visiting scientists, 739 foreign researchers[47] (314 of them from Europe) and 1,156 students in various forms of training. The budget for 2008 was about 98 billion yen[48]. They look first to industry, and only some time later to education[49].

Riken is all this and much more, and we shall describe it in the pages that follow – rigorously, but without obsessively seeking a model, certainly not in the sense this term usually has, and not only in organisational analysis. In short, there is no promised land to conquer here, no "one best way" to theorise, because never-never-land belongs in fairy tales, and because the historical, institutional, cultural, social and environmental differences between Europe[50] and Japan make the idea of importing models forbidding to say the least. And because no one is perfect, and Riken is, of course, no exception to this rule. And because we are not dealing only with scientific research or organisational processes here, but with scientists and managers, and, very often, as we shall see, a mixture of the two: people who collaborate, compete, select, find meaning, decide, make discoveries and mistakes – by genius or by chance. Because they have a system behind them – the Japanese one – that supports them in their projects, and, if they are good and their ideas come off, rewards them.

## 9. We need networking

Doing top-level research is Riken's first and fundamental mission. To do top-level research one has to be competitive at the highest level. To be competitive at the highest level one has to be able to collaborate at the highest level. This is not a new Japanese slogan. It is the philosophy of Riken's managers,

[47] Including Visiting Researchers.

[48] Around 580 million euros.

[49] The Brain Science Institute is particularly active in this field.

[50] If – and, unfortunately, it is a big if – it is still possible to refer politically to our dear old continent as such.

whose main spokesman and interpreter is President Noyori. The idea is that in the period of the liquid society, knowledge and the internet, more than ever before competition is not enough to win. People need to collaborate and interact, knowing that many are going to almost reach the finishing post, but, as always, only one is going to win.

Noyori's philosophy is clear, like his strategy – which aims at networking capacity as an essential component of the competition processes, structurally and humanly[51]. There are two key words: competition and collaboration. The winner is the one that gets there first and shows originality of vision and the ability to translate that vision into reality. But the field is so vast that winning is impossible without sharing data, information, points of view and knowledge.

A paradigmatic example is Carninci's collaboration with the Encode programme, launched in 2003 by the National Institute of Health (Usa), with the aim of developing new technologies[52] for analysing the genome and applying them to 1% of the Dna. When the mapping of the genome was complete, it seemed clear that understanding how it worked was almost impossible: it was like holding a book with a monotonous sequence of 3 billion G, A, C, T[53] in a line without knowing where each word begins or ends, and with no idea of the punctuation or the grammar. Identifying the areas that codify by protein meant being able to understand the words. Now we are trying to understand how the words are linked to each other. The next challenge is understanding their logic.

Competition. Since 2001 Riken has been developing its own technology to understand where the mRna[54] and their promoters are[55].

[51] This topic will recur several times in the article; Philippe de Taxis du Poët, for example, recalls the decision of the Eu delegation in Tokyo to create a network of European researchers in Japan and Japanese researchers in Europe with the declared aim of putting them in touch with each other.

[52] Protocols to transform Rna into information.

[53] Guanine, Adenine, Cytosine, Thymine.

[54] The messenger Rna that produce proteins.

[55] The sequences that let the genome perform its main function: producing Rna, every type of Rna, which not only has the function of carrying and translating information, but also that of helping to regulate the expression of Dna, coordinating the complex work of integrating the thousands and thousands of active components of the cell and making them efficient. In practice, the promoter is a switch that says "switch on", "switch off", and if it is "on", how much needs to be produced. The various tissues express different Rna and hence

Collaboration – such as the Riken technologies that complement those of Encode, and the use by Encode of Carninci's technology for identifying when genes start to be transcribed and the promoters, and understanding how and when the genome acts.

Competition again. Noyori has no doubt about it: you win if you can attract the best talents from every part of the world[56], knowing that to attract the best scientists the living conditions for researchers and the capacity to attract the best young people are important[57].

Collaboration again. The Riken President's vision gives very high points to the capacity to reward merit, organise talent, develop the possibilities of collaboration in all its forms, and to do research with institutes and centres of excellence from every part of the world. Noyori is quite categorical on this point: the capacity of international collaboration, of coherent national systems, research institutes, businesses, and even individual researchers is the crucial factor in competitiveness in this new century. Significantly, he adds, internationalisation processes are a constant in Riken's activities, and in March 2008 it could boast collaboration agreements with 110 institutes in 30 different countries and regions, while more than 120 research projects were activated and achieved thanks to this kind of agreement. The result? Riken is today a world-class centre of excellence with activities that can credibly be compared with those of the Max Planck Society.

Noyori insists on underlining the difference of approach between the two institutes: while the Max Planck Society is the sum total of many independent institutes, Riken strongly encourages integration and collaboration with different institutes and between different research elements; the very possibility of promoting the development of new research areas is strongly correlated with the spread of these processes of integration-collaboration.

different proteins. For example, the muscle expresses proteins needed for muscular contraction, the brain expresses proteins that are important for neuron activity. Different promoters control the expression of different Rna (and hence proteins) in different tissues; in this context the Rna that do not codify retroact with Dna, modifying the expression of mRna from Dna and so modifying the level of proteins produced by Rna.

[56] Of course, being aware that the knowledge and talent of researchers are the fundamental resources does not mean losing sight of the fact that the knowledge of any researcher, however extraordinary his talent may be, is by definition limited.

[57] Much has been done with this end in view, starting from summer courses for business students from abroad.

The idea is to keep together many types of research, give the research as many variables as possible, and make integration the strategic axis for Riken's success and growth. It is this strong conception of the processes of integration-collaboration that explains its strong interest in creating high-quality research infrastructures for the scientific community[58].

## 10. Riken Machine

The bureaucratic side of Riken's strength, how people and resources are directed towards achieving a collective aim and organised on the basis of impersonal, impartial and independent rules and procedures is revealed by Yasuaki Yutani and Soh Osuka. Their starting point is the Mext[59], which for Riken is a kind of parent organisation and fundamental reference point. Notwithstanding Riken's guaranteed prerogatives as an independent institute, it is the Mext that indicates the aims to achieve while the institute prepares medium-term plans and research programmes in keeping with the aims indicated.

Winning sufficient budget quotas is by no means simple, partly as the current trend in the Japanese government is to increase competitive funds[60] and reduce the annual budget for individual institutes; the planning section of each centre or institute has the task of reducing the space between request and award as much as possible[61]. The situation is differ-

[58] The synchrotron, the Omics accelerator and the quantum computer are some examples (www.riken.jp).

[59] The Mext (Ministry of Education, Culture, Sports, Science and Technology) handles 66% of government funds for research and development (15.4 billion euros, out of a total of 23.4 billion euros in 2007); even though Riken's budget depends formally on the Finance Ministry, when Riken makes a request for financing of a programme or research project it is really the Mext that sets up an Advisory Board to evaluate and decide whether to accept and how much to provide. The *iter* of the financing can be summed up roughly as: Finance Ministry-Mext-Riken; at present most research budgets last for around five years.

[60] These are public funds open to all competitors with the necessary requisites; in 2007 15% of Riken's budget came from this type of fund.

[61] Each centre has a research promotion division and a planning division. The latter also negotiates its budget with the Mext. The requests for financing must respect the maximum limits fixed by the Mext for the overall budget and the Policy Planning Division must make the necessary adjustments for the various projects to remain within these limits. Even though the planning division belongs to the administrative and not the research section, at Riken

ent in the case of national projects requested by the Japanese government through the Mext, such as, in the case of Riken, the projects on proteins and the supercomputer.

Year by year, through the Independent Administrative Institution Evaluation Committee, the Mext evaluates Riken's activities on the basis of its individual programmes and research projects. There is an evaluation system that goes, in descending order, from S, the highest, to D, following the scale S-A-B-C-D.

Far and away the majority of Riken's projects receive an S or A evaluation, which is thus considered the institute's standard. When the President, who constitutionally and traditionally has the last word here too, decides the allocation of the budget, in practice the quantity of funds to assign to each institute or centre is made on the basis of these evaluations as well as of the results of reviews[62].

It is also worth mentioning that since Noyori became President the procedure system has grown much stronger. While in the past each institute or centre proposed its own plan to the Planning Policy Division, which followed the steps already described, today each has its own Advisory Board, while the advisability of financing a project and requesting funds from the Mext is indicated by the Research Priority Committee[63] to the President, who, of course, has the final decision.

Two other bodies that assist the President are the Riken Science Council, which has a decisive role in identifying new research areas, and the Riken Directors Meeting, a sort of executive board made up of all the directors of the various institutes or research centres, where the institute's strategies can be discussed.

The recommendations and reviews of these various bodies help the President decide on the quality, prospects and effectiveness of a particular project, and hence if it should be given the green light, financed and supported or not.

these positions are held by graduates in scientific disciplines who are able to discuss seriously both with researchers and with the officials from the Mext.

[62] The evaluation system that is the basis of the reviews was created at Riken about 15 years ago and is now a very important link in the system's chain.

[63] A body created to indicate to the President the priorities for financing.

## 11. More than understatement

They do not like it being said, and still less written, but Franco Nori and Piero Carninci are two of the modern lords of technology, working untiringly to conquer new frontiers, and make possible today what was impossible before, with all that means in terms of opportunities, improvement of living conditions, quality and prospects for people and organisations, and, let's be honest, in terms of concern for a world that seems without limits.

Nori and Carninci are bursting with talent. Nori has more than 240 publications and more than 5,000 citations in reviews such as *Science*, *Nature*, *Physical Review Letters*, *Nature Materials* and *Nature Physics*. Carninci has more than 8,000 citations for his 150-plus articles published[64] in the world's most prestigious scientific reviews.

Yet, despite their extraordinary talent, their response to the question as to the importance of people and organisations in deciding the results of scientific research is closer to Weber and Taylor than Schein and Weick. They are in complete agreement with Noyori. They reminded me in their own way as we said goodbye a few hours before I left Tokyo, urging me not to write too much about them but to focus on Riken and on its extraordinary research environment, which allows them to work in the best conditions for achieving their goals.

Understatement? Only in part. What else will become clear when we describe the quality, the methods for measuring effectiveness, and how results are evaluated. We shall focus on two examples, the Omics Science Centre and the Digital Materials Laboratory, and the comments collected in the course of many interviews and conversations, in particular with Piero Carninci and Franco Nori. With them we shall cover a significant part of the ground in search of the necessary, basic characteristics of effective science, and how to organise it. Step by step, we shall come upon well-known and less-known facts, and some not known at all. Starting, of course, from how the members of a team are chosen and encouraged, and given the will to look beyond the obvious paradigms.

Selecting human resources and identifying the most suitable researchers for working in one's group is a particularly delicate task for a team leader; making good decisions in this phase is fundamental for obtaining good re-

[64] As we have already observed, biological papers are usually cited more often.

sults later. The fact is that choosing the right people is a particularly difficult job; copper-bottomed intelligent decisions do not exist, results and time continue to be capricious variables, difficult to control, and this simply makes more urgent the need to define decision-making processes that make error less likely.

## 12. Omics Science Centre

Three teams with the task of building a system, the accelerator; two with the task of defining the basic technologies that can be used by this system: this, reduced to essentials, is the Omics Science Centre, which began its work at the Riken Yokohama Institute on 1 April 2008[65]. For the next five years it will be a centre, and the hope is that its results will be such that it will become an Institute.

Yoshihide Hayashizaki is the director of the Omics Science Centre. He is a scientist-manager of quite extraordinary vision, who has always followed the idea of creating systems to understand science and nature. The vision behind the new centre is his: creating a Life Science Accelerator, a system[66] to accelerate the study of biology, develop an all-embracing approach to biomedical research, analyse Dna, proteins and their functions to identify, for example, gene X responsible for illness Y – in other words, the phenotype[67].

At Omics Carninci is in charge of the Functional Genomics Technology and the Omics Resource Development Unit, and is Vice-Director with Hurukazu Suzuki of the Lsa Element Technology Development. His task is to focus on different miniaturised samples that have a very specific biological significance. He must ask questions and seek extremely focused answers with the aim of developing methodologies for working with neurons and/or nerve cells, which by nature are difficult to isolate in large quantities[68].

[65] Of course, this was possible thanks to decisions, choices and activities begun long before.

[66] Oversimplifying, it can be described as a series of machines, instruments and computers.

[67] A series of morphological and functional characteristics in an organism resulting from the interaction of its genotype, in effect all the genes that make up the hereditary characteristics of an organism or a group of individuals, with the environment.

[68] It means isolating the few cells (neurons) of the brain that are similar and using various methods to observe what they do specifically.

There are various applications for this integral approach[69], which aims to analyse all the areas of the genome that cause biological phenomena, to try and understand what has so far escaped us, as in the case of mechanisms that regulate the brain's plasticity (of which more later).

At Omics there is much interaction between the various teams. The working environment itself is decidedly open, underlining the need for spaces of constant interaction not only during the seminars, briefings and meetings, but also in the course of ordinary activity. The aim is to match the various research activities, develop collaborative capacity to the maximum from the outset, when a subject is identified and the tasks of each team are defined, to the end, when the contribution of each researcher to the research is evaluated and it is decided how to publish the results[70]. The team leader has the last word, but he must be able to evaluate everything with authority, experience, balance, depth and detachment.

Carninci's career aim is to have as many credits as possible as final author[71] because they testify the capacity to train young researchers. The more young researchers one trains, the better – for them, for the team leader and for Riken. Because training researchers 10/15 years younger means an excellent input for the group[72]. If a scientist aged 43 continues to publish works as first author it certainly means that he is working himself, but it means above all that he is not training others and this is not good; of course, one can be the first author of a very ambitious project that a young man might not yet be able to coordinate, but Riken has a high regard for this capacity to train the members of a laboratory, make them work together and be followed by them, and to ensure that everything works properly.

In matters of this kind a bureaucratic approach is not enough. What counts is interaction, the spark between people, when two researchers know each other and interact, and discover they are both after something; it is like walking down roads that sometimes intersect and are sometimes parallel; that is when things really work.

[69] In the sense of studying the expression of all genes at the same time.

[70] It is very important to adopt methods shared by the team, discuss with them and those who have done the work, and evaluate the different contributions until agreement is reached. Usually this is easy, but sometimes there is conflict.

[71] The final author is the coordinator and director of the group.

[72] In Japan the University works like this too.

It is a question of active environments, in Weick's sense of enactment, of the capacity to set off continual interaction processes. In scientific work much is based on this capacity, which requires networks of trust, contacts with people with whom one has already worked and who know the characteristics of the group and how it works, the kind of skills and approaches needed. Choosing the right people also matters, insists Hayashizaki. It was he who brought Carninci to Japan. And he underlines that to choose the right people one needs method, attractive research environments, scientific competence, relational capacities, independent judgement, adequate resources, responsibility, patience, and even a little bit of luck – all decisive characteristics when one is finding candidates, selecting them, and talking to them to see if they really are what one needs.

Intuition is necessary to sense the candidate's personality, understand if he has the explicit and tacit knowledge, the mentality and character to do that particular job well. A shy person may not always express himself well at interview, but this does not necessarily mean that he does not have the potential and capacity to make him worth signing up. Similarly, researchers whose knowledge and competence is excessively structured and who are too self-confident, may prove unsuitable for research activities like those at Omics, where they need researchers who are not only highly trained, but also adventurous and willing to do things differently from elsewhere, or from what they were doing before – who are able, in short, to tackle something new.

The candidates with greatest potential are those who have already been successful, have already done something good elsewhere and want to change; getting them is the ideal. At the other extreme there are those who want to carry on doing, perhaps with more advanced methods, exactly what they did at university, such as analysing a data setting, but more quickly than the others. This is a muscular kind of competition, without any innovatory thought, and the Omics Science Centre is just not interested.

So it is not just explicit, codified knowledge and implicit, experience-based knowledge that are important, but also the willingness to strike out on new paths, the desire to explore unknown territory with the determination of those who know that at the end of the journey the only thing that will really count are the results.

When they speak of researchers seeking out unexplored paths Hayashizaki and Carninci are referring to many things: approach, methodology, and the capacity to observe data from different perspectives and spot as yet un-

known connections. What already exists is the initial data: on abscissi A, B, C, and ordinates X, W, Z; the winner is the one who can look at the data carefully, explore all their possibilities, discuss the matter with capable colleagues, and spot the associations that make it possible to conceive and achieve something new. That is how discoveries happen and results arrive – even when (surprise, surprise) they look completely different from what had been planned or imagined. Sometimes this is because there has been an error. These are questions of serendipity – that serendipity that helped Fleming discover penicillin and that helped Carninci to "confess" with amusement that his discovery that a sugar stabilised a series of enzymes was helped by the fact that he set the instrument at the wrong temperature. Many works should be re-written with greater originality.

## 13. A dip in the past

In early October, 2005 I read about Piero Carninci, a scientist from Trieste who was director of the Fantom International Consortium with Yoshihide Hayashizaki, supported by the Riken Genome Network Project with 45 institutions and 192 scientists from 11 countries. I wrote an article for the online edition of *La Stampa* in which I cited Jerry Donohue, the young American crystallographer who was at the Cavendish for a certain period, and who, according to Watson, apart from Linus Pauling knew more about links with hydrogen than anyone else in the world[73], and who revealed to him and Crick that the tautomeric forms[74] used in text-books were wrong and helped them identify the structure of the double helix. I added that in science events of this kind are not rare. I pointed out that thanks to the work of the Fantom 3 we were faced with a new epochal change, given that the rule "one gene, one protein", by which the information in the Dna flows in one direction to the molecules that transcribe and translate it into the language of amino acids, had been definitively questioned; that the centre of attention

[73] Watson J.D. (1982), *The Double Helix,* London, Weidenfeld & Nicolson.

[74] Tautomerism: type of isomerism (phenomenon by which compounds of the same molecular weight and empirical formula have a different structural formula, and hence different physical and/or chemical properties) between a compound containing a ketone group and the compound deriving from it due to the migration of hydrogen atoms, thus transforming the ketone group into a tertiary alcohol group.

now was the "transcriptome" (Rna); that there are 180,000 different types of them in a single mouse-cell and that their function is not just to carry and translate information but also to help regulate the expression of Dna[75]. The same day I wrote to Carninci to suggest the interview that was later published in the January 2006 number of *Technology Review*[76].

His discovery and the new horizons it opens up are related to the "unforeseen", "anomalous" and "strategic" characteristics that Merton finds typical of serendipity.

Carninci explained that the initial idea was consistent with the central dogma of molecular biology: the genome produces mRna[77,] which in turn produce proteins. At the time[78] it was also thought that there were 70-100,000 different genes that encoded proteins, and these estimates derived from quite complex measurements on the number of Rna in a cell. The data on the cDna[79] analysed by Carninci and his team gave results consistent with the previous theories, those of 70-100,000 genes, but contradicted the number of genes found, around 22,000, in the genome of human beings and mice[80]. The analysis of cDna led to the discovery that a good half did not encode any proteins, but it took a long time to understand that these cDna were not fragments of genome that had been wrongly cloned, but a significant number of different Rna that do not encode proteins.

The anomaly, the surprise, came when analysis of the cDna showed that these Rna had nothing to do with the "central dogma" – they did not encode any proteins. At first no one knew what to do with them. The one thing certain was that they were not wanted. They were assumed to be a useless artefact produced by the experiments. In the course of a meeting in August 2000 one researcher insistently claimed they were just junk.

Carninci underlines that "it is significant how long it takes for new observations to change old dogma. It was an important lesson to see at first-

[75] The Rna bring the Dna the information necessary for it to release information in its turn.

[76] Moretti V., Massa C. (2006), *Per genio e per caso,* in *Technology Review Italia,* IV, no. 1, January-February.

[77] Rna messenger; during the transcription it converts the information contained in Dna into protein.

[78] Towards the end of the 1990s.

[79] Complementary Dna, i.e. Dna copied from an mRna.

[80] Common domestic mice.

hand how inflexible we scientists are too"[81]. I reminded him that, significantly, "of all forms of mental activity the most difficult to induce […] is the art of handling the same bundle of data as before, but placing them in a new system of relations with one another by giving them a different framework, all of which virtually means putting on a different thinking-cap"[82]. He agreed absolutely, adding that, fortunately[83], at a certain point they noticed that these Rna are expressed in various tissues, have different regulations, and they wondered what they might be doing, if their presence might help interpret some mechanisms of gene regulation, or regulation of the differential splicing[84].

## 14. Omics Science Centre, again

Sometimes ideas are born in the solitude of the shower or while one is flying to the other side of the world, and sometimes over coffee with lab colleagues, but more often when one is thinking in company with others, discussing the ideas, technologies and progress of other researchers in other parts of the world. It is not easy, of course. As with real friends, the scientists with whom one manages to set up a genuinely fertile interaction are rare, and they become the people with whom one shares the most satisfying intellectual experiences, and sometimes one's best friends.

Hayashizaki and Carninci are in no doubt about it. The idea behind the Omics Science Centre, the possibility of analysing all the available variables on a single type of cell at the same time with the aim of finding a specific answer for every specific question, is really exciting[85]. In any case, it is different from that of Encode, the American research consortium which is decyphering the encyclopedia of the human genome. While Encode is trying to read,

[81] Moretti V., Massa C. (2006), *op.cit.*

[82] Butterfield H. (1949), *The Origins of Modern Sciences, 1300 -1800*, London, G. Bell & Sons, p. 1; cited in Merton R.K. and Barber E. (2004), *op.cit.,* p. 265.

[83] Actually, as Merton would say, thanks to theoretically aware researchers able to see the universal in the particular.

[84] Splicing is the mechanisms that cuts and re-sews the eukaryotic mRna in shorter pieces that are then used by the cell in this form to produce protein.

[85] We owe to A.N. Whitehead the idea that "thinking is an extraordinary form of excitement".

understand and encode the individual words of the encyclopaedia of Dna, Omics is starting from the single word, the cell, to observe, understand and encode the whole volume of information concerning it as it becomes a cell or a whole organism. The aim is to find the rules and behavioural models that are behind the dynamics of the biological process.

At the moment we lack a complete vision. There are glimpses of light and theories analysing 0.01 of the available data; it is like peering through a keyhole or opening a book one knows nothing about and reading a phrase: it might open up new worlds, but one might also be barking up completely the wrong tree.

The gamble is to try and read the whole volume. In Carninci's case reading the whole book on neurons to observe how they act, what they do before, during and after the phase of maximum plasticity. The starting point is the fact that certain cells and some types of neurons determine the plasticity of the nervous system and guarantee its necessary elasticity so that they can learn to perform certain functions, like learning a language[86], for example. The next stage of investigation will be the molecular mechanisms that are determined and active within this type of neuron. It is an enormous body of data that has to be analysed to understand what has remained constant and what has changed, what was not there before and/or during and after, and vice versa. In this way one can think of inverting the process and bringing the level of plasticity back to the previous phase. Once the whole network has been reconstructed we shall be able to understand how to proceed. It will not be easy. But it is realistic, and exciting.

Until yesterday, for the individual neurons, there was no method for linking the Rna to the specific region of the genome that controls their expression. He and Charles Plessy[87], explains Carninci, have been trying to supply an answer to this gap. It has not been straightforward. The initial path seemed very promising, but then seemed to be going nowhere. In November 2006 they decided to adopt a completely different method, which they had not used so far for various reasons, mainly because it produced an artefact that prevented them proceeding with the experiment. Modifying the existing technology they managed to get this artefact to e-

[86] A process that significantly reaches it maximum level of effectiveness, in childhood.

[87] A member of Carninci's team as researcher (Ph.D.) at the Genome Science Laboratory and now at the Omics Science Centre.

liminate itself[88] in the course of the experiment, and this allowed them to achieve their aim, get the results, and open windows onto new and unexpected vistas.

With hindsight it all seems almost predictable, but really, to conceive and put together those steps, to create the chain, completely new methods and practices had to be defined that are still not fully understood. In a standard approach, a rigid scheme, everything would have been thrown away long ago as the results were not what was expected. But it was very important to stop, think, observe, think again and observe again.

Sometimes at night you dream about what you are doing; you wake in the morning and try the experiment again and still don't see what you thought. So you try to understand what happened, to make further changes. Intuition comes from observing the data, from trying to do many different and complicated things that you cannot be sure will work. It comes from the capacity to look carefully at the result of the experiment and to interpret what happens. Once again, questions of serendipity that happen more often when there are interactive processes, discussions with others, and lateral processes, and when the people with whom you are working have been chosen well. It is a question of connections: minds are complementary, and, put together, they help each other develop.

Team quality, efficacy and efficiency grow and consolidate in many ways – the work, attending conferences, discussing the content of articles published in reviews like *Science* or *Nature* with the aim of developing the capacity for critical interaction, with scientific seminars in which each person in turn describes his research to the group[89], meetings in which the people working on it analyse a project, and the exchange of ideas that might last only five minutes while you are working in the lab, but often prove very useful.

It is very important to know how to put yourself at the service of those working with you, explains Carninci. Being the boss is easy, but directing and developing a team is much more difficult. If you want to achieve certain results everyone needs to be more autonomous, more independent, and more able to stand out as real team leaders. And to do this they must feel free

[88] In practice, this "suicide" is induced thanks to its dimensions, smaller than the Rna that are being studied.

[89] Everyone examines his own results, presents data, roles and paths followed and starts the discussion with the others; everyone can suggest alternative procedures, different implications of their work, or discuss an article published by another research group, etc.

and relaxed, and able to interact without worrying too much about losing control or helping colleagues without any recognition for themselves.

In many ways it is a constant work of retrospection[90] by which the group defines and reinforces its identity on the basis of discussion and sharing, and the more this produces shared results the more it reinforces the sense of belonging to the team and the desire to work actively for the team to be recognised[91].

Bringing on those around, teaching them how to research, being both a leader and a manager and knowing how to make best use of the team, should be for many reasons the aim of all team leaders. One can do it more or less well, of course; there are even those team leaders who work only for the group and not for themselves, and this too is a problem, because in this way they end up creating too little, reducing what should be an extensive area of intersection in which what one does for oneself one also does for the group.

Continuity in work is also fundamental for success. Significantly, all the researchers selected for Omics were offered a five-year contract[92], longer than is usual for Riken. But in biology preparing data traditionally requires time and the minimum period for obtaining results is two-three years. For organisations like Omics, once the right people have been chosen and the team defined, the aim is not to lose researchers, but motivate them to stay for the whole research cycle[93], on the understanding, of course, that everything happens in an open system where the reasons for something are just as important as the thing itself.

For example, if a researcher is lost because he has published an article in *Nature* it means that the research is working and so the team will be given the resources to replace him. The more of Riken's people who become important researchers, the more Riken shows it is a successful research institute.

[90] One of the characteristics of sensemaking processes.

[91] Those who do most of the experimental and computer work appear first, followed by those who helped in various things but not as leaders. The senior figure who often had the initial idea and who coordinated the resources appears as the final author.

[92] The position of junior researchers is slightly different.

[93] It is counterproductive and hence rare for a researcher to leave his team before completing the research cycle.

## 15. First intermezzo: the highest aim

Susumu Tonegawa, Nobel Prizewinner 1987 for Medicine, left Japan in 1963 for the USA, where he worked for a time at the laboratory of Renato Dulbecco, who had won the Nobel in 1975. During a recent visit to Riken Tonegawa recalled how three Nobel prizewinners apart from Dulbecco had emerged from that laboratory: himself; Howard M. Temin, a pupil of Dulbecco and, along with David Baltimore and Dulbecco co-winner of the Nobel in 1975; Leland H. Hartwell, Nobel Prize 2001 for Medicine. This shows unequivocally that Renato Dulbecco is a great *maître à penser* who can rightly be more than satisfied with the quality and level of interaction that he created in his laboratory.

Carninci and Nori are in no doubt on this point: this is an extremely gratifying aspect of research work, and in many respects the highest aim.

## 16. Second intermezzo: Genome Story

The story of the genome would certainly have been different without Renato Dulbecco, his ideas and his vision. It is difficult even to imagine, but when in 1986 he launched the Human Genome Project, with the aim of deciphering our genetic patrimony and, as he would often repeat, achieve full knowledge of our genes and the genes of every species, the level of technology was so far from that of today that it was like going to the moon on foot. At a certain point it seemed that the Genome Project might start in Italy, thanks to the interest of the then President of the national research council Luigi Rossi Bernardi. But how did it all end? The necessary funds were never found. The system of Italian research remained completely outside this extraordinary research programme. Italy today depends for this kind of knowledge entirely on foreign countries, with the United States and Japan leading the field. This was an extraordinarily important opportunity that was lost.

## 17. Digital Materials Laboratory

The Digital Materials Laboratory (Dml) is directed by Franco Nori. Here physical models are used to elaborate theories that move in the intersec-

tion between atomic physics, quantum physics and condensed matter, which can be verified experimentally or understood by observing the phenomena they produce[94].

At the Dml, as in all the research laboratories that make up the Single Quantum Dynamics Research Group, there are annual controls that are extremely analytical and detailed, as desired by the "big boss", Akira Tonomura. He conducts the controls personally on the basis of an algorhythm of evaluation he himself drew up, which takes account of the number of articles published and the impact level of the review in which they appear. Those with the best results are rewarded with greater financing for the group, reinforcing the culture of merit in the Sqdrg and the Riken system generally. Articles are also evaluated by external readers. For example, the article published in March 2008 by a team from the Dml made up of three researchers from China, Sweden and the Usa, will be evaluated in 2 or 3 years by a specialised company, Halsan, on the basis of the number of times it has been cited[95]. Then, of course, the traditional checks will be made. The latest medium-term review, conducted by a very prestigious international control group, in a generally flattering judgement noted the excellent result of the Dml. Kohei Tamao, who was director of the Frontier Research System at the time, was very pleased with this result and made support and resources available to the Sqdrg.

Nori sees himself as a kind of coach or trainer, but he is actually the team's star player[96], a decision-maker with great freedom of movement: it is he who indicates the path to follow and decides on the projects to be given priority, who synthesises, organises the research teams, and defines their composition, the criteria for allocating resources, and the methods of financing the work of the researchers in his group.

[94] The projects on which the Dml is currently working include quantum computing, the study of the superconductors of qubits by means of the Josephson-junction, scalable quantum circuits, vortex dynamics in superconductors the new fluxtronic devices, and devices that can control quantum movement.

[95] Comparisons, obviously, are made for each sector, as the dynamics and ecology of each group are different: usually in physics seven citations a year is considered very good; for mathematics even fewer, while for biology more are required.

[96] Of course, if asked, he will reply that he plays too sometimes, but usually it is the other members of the team who are kicking the ball.

The number of researchers at the Dml is very variable although the trend is increasing[97]. In most cases they are researchers who study and research in other countries (Ukraine, China, Taiwan, Russia, Germany, Switzerland, England, Moldavia, Jordan, Italy) and who on average are at Riken for between two and four months a year[98], although they often return various time in a year or over the years[99]. Usually, Nori prefers researchers from countries like China, Ukraine and Russia, who have a strong tradition of scientific study and investment, and whose researchers have had excellent training.

There are no fixed places at the Dml, nor are there at the Sqdrg. Contracts usually last a few months, a year at most, and they are naturally renewable according to mutual availability or need[100]. As its leader claims, the Dml is a laboratory of short, medium and long-term visiting researchers.

Nori too chooses each member of his team personally and regards the selection process of resources as very complex; it is hard to say what and who will work or not, who will produce results in the necessary time and who will be too slow. What is certain, he adds, is that decisions are quicker and responsibility for choices clearer. In his view what is essential is the capacity to distinguish in every phase of research between the objective elements of problems, such as a not particularly profitable strand of research, and subjective elements, to do with the limits of researchers who are just not good enough and whose results are consistently weak.

The organisational model adopted by the Dml is as simple as it is functional. Usually Nori sub-divides the team into groups, following a scheme that has been consolidated over the years: each group, consisting of a leader and 2-3 researchers, works on a specific topic; Nori coordinates

[97] In January 2002 four people worked at the Dml, including the secretary; by the end of the year there were between 6 and 10, in 2004 between 12 and 16, and in March 2008 between 12 and 20.

[98] Some remain a week, some a month, some 2-3 months, some 6, some 1 year, some 2-3 years; in March 2008 the record belonged to a Russian scientist who had been with the Nori group for 5 years.

[99] Being able to tackle complex problems that cannot be defined in a few weeks or months is an important opportunity for Riken researchers.

[100] It is worth emphasising that these are researchers who usually have a permanent relation with institutions and research centres in their own country; it is, of course, a different matter if and when a researcher leaves his country to transfer full-time to Riken.

with the leaders of the various groups, who in turn interact with their collaborators. Plenary discussions are less frequent[101].

In the meetings it is sometimes Nori who suggests subjects and ideas, but more often the leaders of the various teams, while Nori plays devil's advocate: there is an exchange of roles, and they discuss areas to develop and those to avoid because they are already too crowded, which articles to read, which conferences and seminars to attend. The time spent attending conferences, reading articles and discussing other groups around the world is very important for identifying the most fertile areas of research. In the last phase, however, quality control becomes crucial: choosing what to cut and what to add or reinforce; identifying results that are not really important and those that are; defining how to present them; and translating all this as well as possible into clearly written and illustrated articles that will have maximum impact.

This is the phase in which the process of the final discussion is developed. The various members of the team ask questions, and one of them, who has been given the role of spokesman, answers; or everyone sits in front of two large screens and the article is discussed; some criticise, some question, some respond; every question and every answer is given X-ray treatment until everyone sees, shares and agrees with the answer.

This is an important feature of Nori's group, a method adopted and consolidated over the years: everybody scanning the article to find some mistake. The capacity to identify errors is fundamental. Nori alternates work at the screen with work on the page; he uses sheets of every size and pens of every colour; he insists on the need to clarify one's theory with illustrations; he puts all those brains and eyes together to find the weak point.

It is harder than it looks. At that level errors are easily camouflaged. Four eyes are better than two, six better than four, eight better than six, as he is fond of underlining. Nori's approach is only apparently didactic; any unnoticed errors would inevitably be spotted in the end by other teams, and so it is better far to carry out one's own review first, using a procedure that allows the whole team to receive the same information systematically from the reader and helps reinforce every single aspect of the work that is to be presented with a note, an explanation or an illustration that will clarify the process followed and the results achieved.

[101] Thus there are usually three levels, in some rare cases four; the fourth level consists almost entirely of students.

For Nori's group this method has become standard practice. For the others, in Japan too, where vertical processes in which the leader decides are the norm, it is less common. It is important for everyone to be actively involved and for the whole team to want to discuss and share each phrase of the article. Another point: once an article has been written it is left for days, and when it is re-read it becomes clear how and where the logic needs strengthening or if some transitional passage is missing. The logical clarity of the article is fundamental. It helps to expound one's ideas well, to interact better with the reviewers, to achieve a higher level of productivity. However demanding and sometimes painful it is, this practice is decisive for improving the quality of the work, and so of the results. It is through this extremely rigorous internal quality control that the final product is so good. It is all these elements together that lead to excellent reviews.

## 18. Wave on wave

It is essential to have a wave of new results every 2-3 years. While the fruits of the previous work are being gathered new technology must be invested in what will become strategic in the next 2-3 years[102], and they must be able to work around what will become important in the next cycle of research. But how in practice do the controls work?

The Advisory Council[103] has the task of evaluating the finished work and Riken's overall results as well as those of the various institutes and centres and individual laboratories. There are normally two controls during the life cycle of a research project, one half-way through and one at the end. The greater importance of one or the other, and its methods, are connected in various ways with the characteristics of the research and the kind of laboratory, centre or institute involved.

In general, one can say, however, that starting from the presentation of the work done by the team leader, project director or person in charge of the research, the Advisory Council measures and evaluates its efficiency,

[102] The leader must be able to handle the pressure, above all on himself: three years spent quickly and working flat-out every day is very important.

[103] The Advisory Council is made up of distinguished scientists, experts and consultants; usually the research centre being evaluated has the right to put forward the name of one member of the council.

the results achieved, and the impact of the research on the basis of various parameters: the number of publications and citations, the judgement of institutes and people belonging to the discipline and/or sector, the capacity to activate and attract funds from other public or private resources, networking capacity, the number of patents, and the capacity to research on a scale different from that typical of the universities[104]. Riken is asked to concentrate on large-impact research, and to obtain good results. What you wanted or could do counts for very little. Without good results it is better to run before being reviewed, as Carninci often tells his collaborators.

## 19. I publish, therefore I am (a good researcher)

Above all, it is important to publish research results. Riken adopts a sort of average efficiency indicator given by the number of years of the research multiplied by the number of group members, and revised on the basis of the actual number of researchers making up the team[105].

Along with the number of publications the scientific prestige of the reviews where they are published is important. Riken has put them in various categories, the most important containing journals like *Nature*, *Science*, *Nature Genetics*, *PLoS Genetics*, *Nature Materials*, *Nature Physics* and *Physical Review Letters*. The impact of the research, measured by the number of times a work is cited, is worth many points. Again, the evaluation criteria are not always the same nor do they necessarily follow the same course, but depend in various ways on the kind of institute, centre or team that is being evaluated. There are institutes like the Brain Science Institute that are organised in many small teams and units carrying out very specific activities, have few technicians and many young Ph.D. researchers working independently and focusing on particular questions, and that interact less than their colleagues doing research on the genome at the Omics Science Centre, where there is a more cooperative approach,

[104] Of course, the universities too publish in *Nature*, *Science* etc., but their approach is usually more focused.

[105] Total number of the research team minus the lab technicians, secretaries and students, who are in various ways important for the successful outcome of the research but who, naturally, do not publish.

more people are usually involved in each activity and the networking is more developed[106].

## 20. Money makes research go around

Another fundamental element of the review is related to the capacity to attract financing, to channel resources from other institutes, companies and bodies towards Riken. It is a capacity encouraged in many ways. A few years ago, for example, President Noyori suggested the possibility of assigning each group additional resources on the basis of a 1:2 parameter[107]; the idea came to nothing because it would have been too expensive, but it indicates the philosophy of the present management. Starting from the junior research associates[108] anyone can play an active role in seeking funds, both from public and private bodies[109]. Of course, it is one thing to seek them, and another to actually obtain them. Crucial factors are the credibility of the proposer, his capacity to have good ideas, to transform them into coherent projects with the aims and goals of the financer and to respect the process's system of rules in every aspect[110], both at institutional level and at Riken's[111].

## 21. The accidental patent

In some respects the question of patents is controversial. Although, as Nori and Carninci point out, there is a strong incentive to patent; at the same

[106] This open approach is also extended to the results, in the sense that all data is made public at the time of publication, with significant contributions to Japanese, American and European databases.

[107] 2 yens of additional financing from Riken for every yen of financing obtained.

[108] Associate researchers, for example with a master.

[109] In Japan the paths are more or less the same.

[110] For example, those asking for financing for projects that are the same or too similar to those already financed are inexorably penalised in the following appeals. The control is made using a database accessible with an ID that connects all the finance bodies, verifies the successful requests for financing and automatically excludes those that are the same or too similar; wasting one's time in duplicating a project already on the database is not only useless but also harmful.

[111] As an example we might take that barring competition between groups within the same institute.

time, to avoid steep and unnecessary rises in costs, a specific procedure has been adopted to request the authorisation to patent by compiling a form that indicates the specification of the possible applications, potential users and purchasers[112].

For the purposes of the review the most important aspect is the fact that usually types of patent (of implementation, improvement, etc.) for a technology are the result of specialised research and not of important theoretical works of the kind that break new ground and that are published in reviews like *Nature* or *Science*.

One paradigmatic example is that of the genome sequence, research of extraordinary importance for the community, basic knowledge and scientific culture, but which cannot be patented because the material is too wide-ranging and has no specific goal.

In short, unlike the situation in companies like Hitachi and Nec[113], for whom patents are an essential part of their mission, Riken, usually during the control of the number of patents registered, assigns a higher or lower number of points according to the level of innovation that they produce, the possibility of starting new commercial activities, and the royalties that the parent body will receive[114].

## 22. That's all, folks

On the basis of what we have seen so far we can draw some first conclusions on what are the main factors for success in the Riken evaluation process. The most important is that of large-impact, frequently cited publications in prestigious reviews. A piece of published research cited dozens of times over the years is clearly important. So is the capacity to attract financing, but it is the publications that make it possible to activate the financing and increase the probability of being able to obtain it; financing is a means, not the end of re-

[112] Patenting often without obtaining commercial results can be counterproductive in the reviews too, because it is regarded as wasteful.

[113] The two examples are not chosen casually; they are two companies whose research activity is directed towards producing goods and that have developed over the years strong interactive systems like those of Riken.

[114] Riken also has a generous system of distributing some of the royalties to the inventor, but this is not usually sufficient to engage strong interest among the researchers.

search activity, and if it does not produce results (and publications and citations) it is destined to remain an episode.

Networking also earns high points; particularly in the Noyori era the quality and quantity of collaboration processes activated is considered a fundamental factor of success. Patents are usually considered less important. What gives importance and credibility to the system is a simple but effective rule: the outcome of the evaluation is decisive for the financing that an individual institute or centre can request for the next cycle of research.

## 23. Lost Generation

Fabio Marchesoni[115] is involved in research at the Digital Materials Laboratory directed by Franco Nori. If it were a Lina Wertmuller film his story[116] might be entitled "how to lose three generations of researchers in just one go, educate kids and be a good bureaucrat ever after". It isn't a film, but I think it is extremely instructive.

He insists that globe-trotting is good for research and for the researchers – above all for the really ambitious ones. The downside is Italians have no choice in the matter. Abroad more is invested in research than in Italy, and set up serious projects quickly and go headhunting teachers, researchers and scientists who can guide young working groups and make them autonomous.

Italian researchers with these qualities are usefully employed not only in England, France and Spain, but in China, Japan, Taiwan and Singapore. Their ages range from 40 to 60; they have the knowledge, the capacity and the international experience to educate and lead teams of young researchers; Italy offers them little, but they can carry out this mission abroad at institutions offering two or three-month contracts a year for five years.

It is a genuine incubator, a sort of start-up for scientific research that gambles on their capacity to transfer the tacit and explicit knowledge acquired over decades and that will, of course, go on increasing during the five years,

[115] His awards and recognitions include the Riken Eminent Scientist Award (2002), the Canon Foundation Award (2003), the Alexander von Humboldt Award (2006) and the Outstanding Reviewer Award (2007).

[116] A longer version of the conversation with Marchesoni was published in May 2008 with the title *Italiani nel mondo: così si sprecano i cervelli*, in *Il Mese di Rassegna Sindacale*, no. 5.

to young researchers who must be able to run a research project for themselves as quickly as possible. In this way a financial investment equivalent to that of a year can make use of the know-how and experience of the team leader for five years, while the team leader at the end of this period will have made an important contribution to a research project and helped create a group that can stand on its own feet.

Moral of the story? In this way our country "loses" three generations of researchers: those Marchesoni's age, who go abroad if they want to do research at a certain level; that of Marchesoni's pupils, now in their mid-thirties, who have become tenured lecturers in other countries as it was not possible in Italy[117]; and the future researchers, now in their twenties, who might have had Marchesoni as their teacher instead of their English contemporaries. The rhetorical but real question at this point is clearly: can Italy allow itself to be so generous?

## 24. Knight's move

Good organisation – good networking capacity – good researchers – good results – good science – good commission – good evaluation – good financing. The idea is that this could be a virtuous circle for supporting innovative research processes in Italy and Europe too, as they struggle with the umpteenth attempt to set up a European Mit: announced, argued over and finally financed, the European Institute for Technology and Innovation (Eit)[118].

It is by no means an easy idea to put into practice. And the difficulties are particularly evident in Italy, given the degree of amoral nepotism that informs the government and much of the university and research system, with the result that many of the best young Italian researchers leave for abroad

[117] See the open letter to the then Minister for Scientific Research Fabio Mussi by Gianfranco Bertone, Giacomo Cacciapaglia, Marco Cirelli, Pier Stefano Corasaniti, Lara Faoro, Alessio Figalli, Marcella Grasso, Riccardo Spezia, Simone Speziale, Dario Vincenzi and Francesco Zamponi, winners of a competition by the French Cnr (Cnrs); on http://www.marcocirelli.net/lettera_ministero.html.

[118] Certainly the experience of the Media Lab Europe in Dublin is not encouraging. According to many it failed precisely because it lacked a connective and innovative tissue of high-level students, graduates and post-doctorial students.

while foreigners tend, quite naturally, to be sceptical about the real opportunities of doing research in Italy.

Changing gear, succeeding in the difficult task of acting quickly and well, is difficult. But, fortunately, difficult does not mean impossible. The most recent example is Spain, until 15 years ago regarded, even more than Italy, as closed, unattractive and unable to create opportunities. Today it is a country that has invested in scientific institutes run with competitive rules that attract hundreds of good young researchers from all over the world.

In cases like this the knight's move is often effective[119]. There are actually five moves. The hope is that they can prove useful for combating more effectively delays and inefficiency; for fostering institutes, environments and areas able to activate virtuous isomorphic processes, encourage the spread and development of first-class research centres; reward quality; and bring out and support people's talents.

## 25. Questions of frame

The first move is connected with the need to define the cognitive frames and place the flux of events in the most appropriate context. Again it is a question of the frame, of maps to be shared, territories to be understood, organisational processes to be learnt and perhaps imitated, choices to be made.

Angelo Volpi talks about it simply and effectively with reference to Japan, which he describes as a country of shadows, of mist-shrouded hills, extraordinary loyal and respectful of those who win its trust and respect[120], a country that prefers lowered voices, modesty and understatement, and that invests strongly at every level in culture and merit, even though it still considers seniority, the family, the clan[121] and the country[122] as important.

[119] In chess, of course.

[120] The trust is not easy to win; in Japan it is regarded as essential to make all necessary checks before establishing a relationship or beginning a transaction.

[121] See Ouchi W. (1980), *Markets, Bureaucracies and Clans,* in *Administrative Science Quarterly,* no. 25, March.

[122] In Japan when business cards are exchanged it is the organisation that one belongs to that is regarded as most important, because, logically, the best people are in the most important and prestigious organisations.

Volpi insists on the extraordinary influence that the culture of merit has in Japan. Science is particularly open, conscious that to maintain and consolidate its positions of excellence, it needs above all to encourage, make the most of and reward the best, encourage their capacity to collaborate and develop their competitiveness. In society, where there is great respect for work and those who work, it exists at every level[123].

In Japan, working seriously means sharing a mission that makes the nation important. There is no job for which one need be ashamed. The weight of respect that tradition even more than hierarchy pays to its superiors is balanced, so to speak, by the concrete possibility of seeing one's efforts rewarded, seeing one's results recognised and rising on the social scale.

Japan is a country with an extraordinary level of sensemaking, partly due to its powerfully felt sense of shared values. This is the key for understanding, for example, how and why the Japanese businessman sees the long-term future of his company as so important: it is here that his son, and after him his grandson and great grandson may find themselves at the helm in future decades. Of course, like his western colleagues, he too knows that to have a future he also needs to survive immediately, and for that reason he will be careful about what happens in the start-up phase and in the five years following, but his mind is on the future more than on the present. The proof of it is in the importance given to innovation and technological development.

Research is seen in Japan as an extraordinary motorway towards the future, the key that will open new opportunities, to leave a mark in society, as is shown by the fact that much basic research is still done today in companies. And it is partly thanks to the fact that Japan has been able to count over the decades on various exponents of the governing class to have a serious vision of the role of science and technology if today that governing class and public opinion in Japan have a shared awareness that staking all on research, the intellect and knowledge is the best choice for a country with a diminishing population and without raw materials; that the future of the country depends largely on its capacity to nourish a system that continues to generate ideas and innovation; that where one produces and how to turn ideas into products remain important questions that come later in order of priorities.

[123] Of course, even the best have to respect shared rules and values, starting from seniority, but in the end they are the ones who will leave their mark.

It would, of course, be wrong to imagine that all this can necessarily be transferred into Europe or Italy; however, accepting that in matters of this kind a cut-and-paste approach is no use does not mean we need not seek possible connections or words and key concepts that might help define useful perspectives for us.

The first move suggests that this work of defining contexts is not only possible but necessary, and its effectiveness is closely connected to the capacity, credibility and will of the various leaders and governing classes to affirm cultures and social practices that see value in the future, in work, in respect and in merit, aspects on which we need to dwell before turning to the next move.

## 26. The value of the future

We are in Naples at the Feltrinelli bookshop in via Ponte di Tappia, run at the time by Luigi Morra[124], for the presentation of the book *Della Lealtà civile* by the philosopher Salvatore Veca. Its basic concepts are these.

Feeling the long shadow of the future on the present is linked to being able to count on that precious resource for each of us – an identity. This comes from the long term, from the stability of the recognition at our disposal and the expectation we have of relating to others in a certain way. When this stability contracts, the wavelength of the future on which we project ourselves with others is shortened until it is reduced to the present, there being no long-term identity available, and our capacity to find our way in the world with others, and our way of defining interests, needs, ideals and hopes changes.

When we have a long future ahead we share it with others and recognise ourselves in it. The question "Who am I?" can be answered "I am one of those who is trying with others to build a society that is fairer or simply different from the one in which I happened to be born". The answer to solitude is company, and in this case we feel in good company. When this future resource contracts, the possibility of connecting with others is restricted too and everyone is more lonely: we no longer know which *we* to use, we seek

[124] Now national director of Feltrinelli's Travel sector, all his life a member of Naples' real governing class, the one used to relying above all on itself, defining oneself in terms of goals and results. Significantly, the political world has difficulty in noticing this class.

substitutes for the *we*. In the end, if we have stable recognition over time we can say that we are with others; the contraction, or worse the loss, of this possibility, condemns us to the worst of fates for beings such as us: involuntary solitude[125].

## 27. The value of work

With the industrial revolution the respected adult became the working adult. A worker's level of wellbeing does not only depend on a reasonable salary but also on social recognition and the level of satisfaction, security and protection associated with the salary. Lack of a job, or worse its loss, is a factor of exclusion, isolation, loss of confidence and frustration associated with loss of status, and in the worst cases loss of dignity.

Thus, a less unjust society must inevitably reward labour not only in the classical forms, such as salary, position, and working hours, but also in terms of dignity, prestige and social consideration, particularly in this phase of development in which short-term contracts will be more and more common and the defeat of the market will lead to loss of self-esteem. "The worker has given his life and his labour to the community and to his employers […] those who have benefited from his services have not discharged their debt towards him simply by paying his salary, and, like his employers, the State itself, as representative of the community, with its assistance, owes him a certain security in life against unemployment, disease, old age and death[126]".

All this suggests many things about the importance of work, yet not enough. Because work is also a need in itself, a value, the basic tool by which people organise, give sense and meaning to their lives, satisfy their expectations of the future, and build horizons in which to cultivate self-esteem, dignity, and individual and social autonomy. Particularly in a phase in which knowledge is regarded as the main productive force, a plural economy prevails, there is continuity between working life and private life, personal forms

[125] See in this connection Hume D. (1739), *Treatise of human nature*, London, John Noon.

[126] Mauss M. (1923-24), "Essai sur le don. Forme et raison de l'échange dans les sociétés primitives", *L'année sociologique*, seconde série, p. 92.

of knowledge and experience become so many moments of interaction in the process of making best use of that capital, and exploiting to the full the so-called general intellect, that André Gorz[127] defines as all the intelligence, culture and creativity produced by a community in unremunerated activities and so without exchange value.

If all this is at least partly true, the first resources to exploit are, as Gorz explains, immaterial capital, human capital, knowledge capital and intelligence capital. This is an important change. It forces us to reformulate the very concept of value, which requires a ruling class able to make profound changes in the cultural and social as well as economic perspective – changes that will make the value of labour, of all labour, a cornerstone of cohesion and development at global level, and avert a future in which all that matters is to be rich, fit and beautiful[128]. Changes that will make labour less and less passive and more and more participatory, that will require a will to learn and a firm grip, even at the lowest levels, on transversal abilities that will allow us to express ourselves using a richer vocabulary, collaborating with others more effectively, and taking decisions more quickly. The idea, basically, is that labour and the social recognition of its value are significantly connected with the possibility of living lives that are more self-aware, more meaningful and more fulfilled – and so more worth living.

## 28. The value of respect

Gerhart Piers describes shame as a profound sense of incompleteness, even in the face of clear proof of achievement and gratification, bringing out the reasons for which the person who is victim of it is made to feel there is something wrong inside him. Richard Sennett mentions it, underlining how respect is closely associated with personal growth, the development of one's abilities and competencies, care of oneself, the capacity to give to others[129], and why, in work as in education, the judgement "you have no potential" is devastating in a way "you made a mistake" could never be.

[127] Gorz A. (2003), *L'immatériel. Conaissance, valeur et capital,* Paris, Galilée.

[128] According to a Bbc survey at the time of the May 2005 elections in Great Britain, 60% of electors regarded appearance as the main requirement of a candidate.

[129] See Sennett R. (2002), *Respect,* London, Penguin.

Actually every human being is "motivated to succeed", is driven to do something well. The point is to develop the professionalism that produces self-respect, the independence that is closely associated with being an adult, and autonomy that is not just acting but requires a relation in which one side accepts not being able to understand something of the other. At bottom, says Sennett, it is this acceptance that guarantees equality in a relation, that allows us to manage for the best the tension between self-respect and mutual respect. That is why treating others with respect is never automatic, even with the best will in the world. And feeling respect means finding the words and gestures that make it convincing.

## 29. The value of merit

Just look at the covers and headlines of the main weeklies and tabloids, at the most popular TV shows, at the mad scramble for even 15 seconds of fame, at quiz contestants trying to guess the number of beans in a jar; or at the day traders now bereft of the internet e-deology[130]. It's nice being rich. It gives prestige and social recognition. It's worlds away from the effort of those who have a job or a profession, or write an article or a book, or paint a picture. And it has nothing in common with the demanding life of a businessman.

The advantage is that everyone can dream of making it. The truth is that more people are born rich than become it, that the need of many is the dark side of the force of the wealth of few in a world that by definition does not have infinite resources, and that all this is hard to reconcile with the criteria of justice that should inform democratic, open societies in this controversial opening of the third millennium. The truth is also that an apology for wealth does not make any less common "the sensation of being sucked into a vortex in which all realities and values are annulled, exploded, deconstructed and recombined; an underlying uncertainty about what is fundamental, what is valuable, and even what is real[131]".

The idea is that we can try to do much more – rewarding merit and reducing, if not actually eliminating, the inequalities that originate in our so-

[130] See De Biase L. (2003), *Edeologia,* Roma-Bari, Laterza.

[131] Berman M. (1983), *All that is solid melts into air: the experience of modernity*, London; New York: Verso.

cial organisation. It is a difficult idea, as we have often seen, particularly in Italy. But being aware that "encouraging merit in Italian society is not easy[132]", and that "in Italy the two essential values of merit, making individuals responsible for their actions and equal opportunities, are replaced by values of uncritical solidarity and weak permissiveness[133]" does not mean giving up the urgent task of affirming the value of merit and fighting for fairer societies in which there is less inequality and more respect, in which education is more important than wealth, and the social recognition of what people know and can do is an essential part of a deep sense of personal self-esteem and of organisations' sensemaking processes. Societies which reward the pleasure, at every level, of doing things properly because that is how they should be done.

All this suggests at least three further questions, that we might refer to the organisation of talent, to the definition of the educational system, and the search for strategies and actions that concretely guarantee equal opportunities for all in expressing and making the most of their talent throughout their lives[134]. The crux of the question is here, in my view, the point that will decide the country's chances of making a radical change and suiting the word to the deed.

One thinks of Guido Dorso, and of the hundred men of steel with strong moral impulses and will, with clear ideas and programmes, who he thought should be entrusted with the Fate of southern Italy; of his praise of the concrete, what has always been lacking in southern intellectuals, with the result that none of the hundred revolutions that they had imagined has ever come to anything[135].

One thinks of Vincenzo Cuoco, and his idea that a revolution should be "desired and carried out by the whole nation for its need and not just be someone else's gift"[136]. A revolution that should represent a need and not a gift, because only then do people really choose the terrain of responsibility and involvement, indispensable factors for any change that aspires to be lasting.

[132] Abravanel R. (2008), *Meritocrazia,* Milan, Garzanti, p. 291.

[133] *Ibidem*, p. 293.

[134] On the subject education-learning-merit some very interesting facts and analysis can be found in Gabriele S., Raitano M. (2008), *La trasmissione intergenerazionale dei titoli di studio nell'Unione Europea*, in Granaglia E., *op.cit.*

[135] Dorso G. (1977), *La rivoluzione meridionale,* Turin, Einaudi.

[136] Cuoco V. (1966), *Saggio storico sulla rivoluzione napoletana,* Milan, Bur, p. 293.

One thinks of Dorso and Cuoco because affirming the culture and practice of merit in Italy's institutions and society really is a revolution, and, as such, will not be a picnic. It will need men of steel, clear ideas and programmes, the responsible involvement of everyone taking part, and policies designed to eliminate any kind of access barrier. With this we can at last pass on to the next move.

## 30. Europe Resource

The second move brings us straight to the question of resources – financial ones, first of all, followed by relational, territorial and organisational ones. No money no research. Without resources there is no possibility of development, particularly technological, advanced development.

The figures tell us, for example, that in Japan 3.6% of Gdp goes on research. 80% of resources come from the private sector, and 63% from industry. In Europe investment in research and development is on average 2% of Gdp and the private sector contributes around 55% of that. In Italy is is 1.1% with the private sector contributing 47.8%[137].

The figures speak for themselves; they show Europe's, and still more Italy's, need to spend more on innovation; they underline the urgency of increasing investment from private industry. Philippe de Taxis du Poët is quite categorical on this point: in a period of global markets, aiming at radical change in one's capacity for cooperation and international competition is hardly credible if it is not accompanied by specific strategies for shortening the present gap between Europe and countries like the Usa and Japan, both in the quantity of resources used and in their composition.

The possibility-capacity of internationalising the economic system, research centres and businesses is the second link in the resources chain. Unlike what happened even ten years ago, today it is practically impossible, even in the Usa, to be competitive globally without adequate capacity for international cooperation[138].

[137] See Ceris Cnr (2007), *Scienza e tecnologie in cifre,* Rome.

[138] When Californian venture capitalists are invited to evaluate a start-up that needs financing, there are three questions they always ask: "What is your business plan?", "What is your management plan?", and "What are your international networking capabilities?". It is

It is indispensable to be proactive about international cooperation, insists de Taxis du Poët. Approaches of the kind "if someone in the world is interested in Europe, they're welcome" don't pay. We need to stimulate joint activities, share information and knowledge, and increase the recognisability of the interlocutor. Much has already been done, partly thanks to institutes like Riken; but very much more still needs to be done.

When the Japanese think of science and technology they think of the Usa and certainly not Europe. For Japan Europe is still Italy and France and Germany and England, the sum total of different countries; you need only make a tour of Tokyo to see the image that the Japanese have of Europe: Chanel, Dolce & Gabbana and Valentino. It's an important image, but certainly not one that transmits the idea of Europe as a great scientific power. This reflects Europe's attitude, concentrated above all on itself, and tending to underestimate Japan, attracted above all, when it looks at Asia, by China and India. Yet Japan is the second world power, invests a lot in science and technology, and offers a stable and solid working environment that amply repays the fact that its entrance barriers are more demanding than China's or India's.

Then there is the question of territorial resources. Philippe de Taxis du Poët underlines that there are territorial clusters in Europe where the closeness of researchers, investors and ruling class creates a good research environment, but that we need to free these clusters from their local dimension and link them up with what is most innovative in the rest of the world. Europe also needs to think of science and innovation not only in terms of specific activities but also of their connections with society, the economy and productive sectors. Questions of social innovation, public perception, its system of regulations, tax measures, technological transfer and intellectual property are fundamental for a society that wants to be knowledge-based in more than name.

Finally, organisational resources – what the European Union needs, for example, to develop capacity to coordinate different national activities. The fact that many countries, once again starting from France, Italy and Germany, are trying to reinforce their relational capacity at international level without adequate coordination translates into a multiplication of effort that does not produce greater results. The more Europe is united, the stronger it

also significant that the European Commission's most recent financing programmes have been more open to international cooperation than ever before.

is – in international cooperation too; the challenge is to improve coordination capacity and to set aside more economic, relational, territorial and organisational resources for scientific and technological development so as to be able to collaborate and compete at world level.

The idea is that we can take up the challenge, following a win-win strategy[139], in which winning means each of the participants choosing to cooperate. Philippe de Taxis du Poët speaks of Soft European Power, of the European way of technological development, and of the possibility of extending and improving the opportunities of all the countries involved to indicate a different prospect from that of the Usa, which uses its capacity to attract the best brains the key for affirming its predominance.

Once again it is a process that is neither simple nor obvious[140]. But this simply makes the need to try all the more urgent – particularly for Italy, which we shall discuss in detail in the final part of this article.

## 31. Universities and business

Words, it's only words… in the words of an Italian popular song in the 1960s. Discussion about the importance of research and technological development might end like that without any radical improvement in the quality of the educational system overall and higher education in particular[141], and without strong connections between the universities and the business world. In that case the question is: what is the university's role in society?

In other countries the answer is clear: the university is the highest point in the process of individual emancipation, it means that the young graduate is at the summit of his process of personal emancipation and so of his sense of responsibility; whether or not he becomes part of the ruling class is another

[139] In game theory this kind of strategy underlines how and why cooperative behaviour will produce more satisfying results for each of the participants.

[140] Philippe De Taxis du Poët says that Japanese students who have studied in Europe with the Erasmus programme for a year have found that when they returned to Japan it was difficult to find work because their experience in Europe, though satisfying to them, was not seen as positive; it was almost as if they had to show that they were still good students although they had been in Europe for a year.

[141] See Casillo S., Aliberti S., Moretti V. (2007), *Come ti erudisco il pupo,* Rome, Ediesse.

matter, but the social recognition of the university as an institution is unanimous and undisputed.

This positive view does not exist in Italy any longer. As an institution, the Italian university is in a state of persistent anomie. Although there are good lecturers who teach and research and handle thousands of students, they are condemned to seeking opportunities abroad that are not to be found at home. The young researchers who decide to work seriously in the university do not find social recognition, but job uncertainty. As many of the best leave, the scale of values is inverted and one is no longer part of the international circuit: why stay or, still more, enter a system that does not select you, does not allow you intellectual or personal independence[142]?

Let me be clear, we are not talking about making the university into yet another training school for the intellectual work force, to be sent out to high-tech businesses. We are talking about finding a way for the university to recover its vocation as an institution that gives its students the cognitive and methodological tools to intervene and interact in various different contexts independently and critically, and at the same time creating environments that can make the most of the specific vocations and competencies of universities, research centres and businesses.

To each his own job. And better opportunities for all. Emphasising as much as possible the interactive capacity between different systems and their desire to create a network in a win-win situation. Impossible? Not at all. Listen to Akira Tonomura, the man that His Majesty the Emperor of Japan declared a National Treasure for scientific merits.

Referring to the Sqdrg, which he directs, Tonomura focuses on the points of connection between university, research and industry in Japan, with particular reference, obviously, to the relations between Hitachi and Riken. He says that the Sqdrg is organised in 4 teams: the Quantum Phenomena Observation Technology Laboratory, which he himself directs at Hitachi; the Digital Materials Laboratory, directed by Franco Nori at Riken; the Macroscopic Quantum Coherence Laboratory, directed by Jaw-Shen Tsai, at the Nec; and the Quantum Nano-Scale Magnetics Laboratory, directed by Yoshichika Otani, divided between Riken and Tokyo University. This means the various teams are directed by researchers and

[142] Of course, we are referring here to all disciplines.

scientists from Japanese universities (Otani), industry (Tonomura and T-sai) and foreign universities (Nori). The next step is in Tonomura's view inevitable: integration, cooperation and internationalisation are the key words for those who want to make a mark in the world of science and technology; at these levels higher networking capacity almost always translates into a higher level of competitiveness.

The Nec, for example, has ultra-sophisticated and complex technology, which the Sqdrg badly needs for its studies and research, starting from those of Nori and Tsai; Riken has the methods and the brains, and knows how to do research. Technology, method and brains are for different but complementary reasons absolutely fundamental for achieving one's aims – both for the Nec and Riken. Consequently, the combination of these different aspects is of fundamental importance for both of them[143].

Simple – and brilliant. As we can see from Tonomura's second example, that of the integration processes between Hitachi and Riken. He underlines that in modern physics many minute entities and nano-worlds are intrinsically connected, so that there is always more need for experimental techniques and research methods. Again, industry has the technology; for example, in the case of Hitachi, the million-volt electro-microscope[144], the only one of its kind in the world. Riken has the method and the brains. Whoever manages to put together technology, method and brains in the best way is going to get the best, most important results more quickly.

The idea is that Italian research has much to gain from adopting effective processes based on respecting simple rules and easily reproducible: putting quality first; encouraging autonomy, decision-making capacity and individual responsibility; defining effective evaluation systems; rewarding merit at every level of the hierarchy.

The idea is that taking to heart good practices and experiences that have been successful all over the world might be a good solution. Of course one can also choose to go it alone. What is indispensable is coherent, rigorous and credible choices – like those we shall describe now.

[143]It is worth recalling in this connection that part of Riken's mission is the search for connections with universities and industry.

[144] Conceived and created by Tonomura.

## 32. Look at the world

At Riken Valerio Orlando[145] interacts with the work of Carninci and his team. He underlines that innovation often starts from a lateral association of ideas, independently of what the data seem to say. The decisive question is: what do you bet that it might work in another way too?

It often happens in science. You take pieces from one part and try to see if they will fit with other parts. Activating environments in which you are exposed to new facts and ideas is, in any case, one of the basic motives for scientific work. Nine times out of ten that's where an idea comes from that leads to a transitional phase; closed, hyper-specialised environments are unlikely to obtain similar results. In some ways it works like that in nature too: it takes what is there, experiments, adapts and invents in ways that only seem to be chaotic and casual; behind it there are actually processes decided by experience and selection.

Innovation means starting from what you have done to build up a sphere of new questions that make up the material which future generations will be dealing with. In the end the innovators are the ones who manage to ask new questions. This is the process that needs to be encouraged, throwing open the doors to brains from all over the world.

Orlando seems to have no doubts: Italy needs to welcome that world of knowledge that it wrongly goes on excluding. The more it shuts itself up inside, the more depressed it will be, the more it will lose any idea of what is happening elsewhere, and the further into the pit it will slide.

It can be done. As long as concrete and coherent choices are made, and there is a proper evaluation of availability and good practices. For example, seeing which universities, which departments and which cultural institutes are available for this purpose and have the space (usually something extremely valuable in scientific institutes) to set aside for it. Defining precisely the requirements, choosing on the basis of a c.v., written application and interview the best candidates, who, having won the selection, will be motivated, geared to results, competitive, and able to attract financing and be present on the international scene.

[145] From 1991 to 1997 he worked in the laboratory of Molecular Genetics of Development at the Centre for Molecular Biology at Heidelberg University; from 1997 to 2001 he coordinated a research group at the Dibit, San Raffaele Hospital in Milan; since 2002 he has been team leader at the Istituto Dulbecco Telethon, first in Naples, and now in Rome.

Too simple? Not at all. In this way 30% of centre A can be used for innovation, and in this 30%, of X square metres, there will be Y researchers, most of them young, with the above-mentioned characteristics[146], who will have a decent salary, a budget and colleagues with whom they can interact at various levels and will have to meet parameters of efficiency, produce results within a given time, and accept shared systems of evaluation of these results. In this way it will be possible to activate international programmes to make first-rate cultural environments available to researchers and scientists.

In universities all over the world there are scores of researchers who would do anything to come to Italy for part of their lives, and this would create a natural motor for making its cultural institutions work, it would bring diversity, innovation and quality. Once again it is a question of activating selective and competitive processes that lead to productivity, good science and so good opportunities for financing.

## 33. Being competitive

It seems easy, as a nice old boy with whiskers used to say on a TV show for the family, but it isn't. For the reasons often repeated. Is it still possible to invert the compass needle? How? And how soon? The idea is that it is indispensable to try. For example by reinforcing the systems of international relations and exposing the local scientific community to different spurs from those they are used to. Investing in exchanges between young researchers at partner institutes[147]. Setting up genuine young scientist networks around serious projects. Determining those opportunities for discussion that are fundamental for creating innovation. Only with first-class, well-organised centres can one really attract the best young researchers, who are naturally interested in going where there are the best opportunities.

All this presupposes scientific organisations whose management is open to the outside world, to discussion, and to the possibility of seeing time-

[146] Obviously we mean researchers who have completed their training and have a doctorate, have done post-doctoral work and are ready to direct a research group, even if small at first.

[147] One of the tools used for this are the training networks of the European Union, which, on the basis of scientific proposals from the network of laboratories, finance the journeys of the researchers from one country to another.

honoured convictions and axioms being questioned. And, unfortunately, the Italian scientific world is unable to adopt this approach enough, both for traditional cultural reasons and for the lack of the necessary resources to develop it.

So far Italy has been helped by its natural vivacity and its contact with beauty, an essential part of its collective experience. In Italy even the non-educated person, in the sense of *educere,* knows even if for merely archaic reasons. But all this is not enough. Nor is the fact, however true, that Italian scientists can make a name for themselves abroad. Quality needs organising. Talents need cultivating. Otherwise nothing coheres. There are no opportunities. The home-grown brains are not encouraged. The ones from outside are not sought.

The result is that the economy is struggling and there is no research. The economy is struggling because there is no research. And it is rarer and rarer to see talented people thinking of coming to Italy to invest in their future. And this is a problem, not only in the scientific world.

Take cooking, says Orlando. Italians are rightly fond of their own, but anyone who travels knows that there are other excellent *cuisines*. The point is that other countries are open to different gastronomic cultures and from these they have started to learn, made experiments, created something new. It is the idea of beauty again: it is like creating a perfume, there are thousands of essences, it is a question of finding the right balance and creating something new that will become universal. This means everything cohering.

One thinks of the Renaissance, when works were commissioned, and beauty emerged through the great social themes. Italian cities still witness it, and are an example to the whole world.

The point is that as far as cultural, educational and research systems go, the Renaissance is no longer in Italy, but in England, France, Germany and even Spain, as well as in Japan, of course, and the Usa, Singapore and China. These are systems that have understood the importance of opening to the outside world, of attracting what is new and different, of creating a relation of mutual interest between those who come, bringing their talents to the system, and the system that uses these talents to activate processes of continual innovation.

So the fifth and last move suggests that we identify top-quality institutes and people who are willing to work hard in this direction and be e-

valuated exclusively in the light of the results produced on the basis of indicators of recognised international level.

It can be done in Italy too. It already is. At the Dulbecco Telethon Institute and the European Oncological Institute, just to give two possible examples. The gamble is to make the examples cohere together. A gamble – as we have seen – that is not easy to win. But it is also on this terrain that the future of the country will be measured, and the new generations will judge the present governing class.

## 34. Praise of lightness

We might conclude our story with the definition of a possible, provisory list of priorities that underlines the need to:

• invest more and better in research, define resources and ordinary activities, plan recruiting, improve collaborative and networking capacity at international level, and activate processes of collaboration and competition;

• make Italy a country attractive for researchers, make choices and define strategies that aim to attract the interest of investors, encourage the interaction of mind prepared in serendipitous socio-cognitive environments;

• activate international calls with the aim of bringing the experience, know-how and capabilities of Italy's finest scientists and putting them at the service of the country's young researchers, carrying out policies aimed at exchanging young researchers, attracting the best young researchers from every part of the world, those that go where there are real opportunities, top-quality centres, and educators able to help them grow and become autonomous;

• select the places and centres that will have the mission of setting off these virtuous circuits, extending the opportunities for those institutes and organisations, especially universities and businesses, that want to become involved in innovation.

But perhaps it is better to conclude by returning to Calvino, his praise of lightness and his vision of science[148] to ask if a light society is not precisely the answer to a liquid society, a lively and mobile polymorphism the alternative to an opaque and viscous conformism, the force of values,

[148] Calvino I. (1988) *Six memos for the next millennium*, Cambridge, Ma, Harvard University Press.

ideas and connections the antidote to the swamps of anomie, uncertainty and insecurity.

The idea is that in Italy it is possible to create the conditions, if we decide to connect the existing beauty, intelligence, creativity, the spirit of initiative, the capacity for innovation and talent with a different culture and method of organising and running universities and scientific research, which needs building to develop serendipitous socio-cognitive environments, activate virtuous processes "by genius and by chance" and determine, in a credible period of 10-15 years a new renaissance. Of course, even the mere possibility that there are so many Serendipity Labs in our future is closely connected to the will of the institutes, universities and social partners to interpret their need, to accompany their growth by encouraging the willingness to (re-)define their identity, activate and give meaning to environments in which researchers work, and incentivate the desire to create a network. In the end, the idea is that a society that is able to give value to the future, to work, to respect and to merit is able, for that reason, to give more meaning, depth and credibility to that prospect.